WE CLAIM:

1. A process for producing a mesostructured organofunctional silica composition with framework silicon centers with an anhydrous formula $(SiO_2)_{1-x}(SiLO_{1.5})_x$, wherein L is one or more organo groups linked to the framework silicon centers through a carbon - silicon bond and x is a fraction of the framework silicon centers that are organofunctional comprising the steps of combining a basic aqueous solution of silicate anions with an acidified solution of at least one hydrolyzable organosilane reagent and a surfactant to form a reaction mixture with a pH between about 1.0 and about 10, aging the reaction mixture at a temperature between 0° and 150°C at a surfactant to silicon ratio effective to produce a mesostructured organofunctional silica composition intercalated by the surfactant and removing the surfactant from the intercalated product by solvent extraction.

2. The process of Claim 1 wherein the hydrolyzable organosilane reagent used to produced the mesostuctured organo silica composition has the formula $LSiY_3$, wherein L is the organofunctional group and Y is a hydroyzable moiety selected from the group consisting of halides and alkoxides.

3. The process of Claim 1 wherein the organofunctional group of the mesostructured organofunctional silica composition contains one or more heteroatoms selected from the group comprising oxygen, nitrogen, sulfur, phosphorous, boron, and a halogen and combinations thereof.

4. The process of Claim 1 wherein the anhydrous formula $(SiO_2)_{1-x}(LSiO_{1.5})_x$ for the mesostructured organofunctional silica composition has a value of x = 0.01 to 0.65, corresponding to the fraction of framework silicon centers linked through carbon - silicon covalent bonds to one or more organo groups.

5. The process of Claim 1 wherein the mesostructured organofunctional silica composition has a hexagonal, wormhole, or mesocellular foam framework structure.

6. The process of Claim 1 wherein the solvent used to extract the intercalated surfactant is an alcohol, which can optionally contain a protonic acid.

7. The process of Claim 1 wherein the surfactant is selected from te group consisting of an alkyl amine, a cationic quaternary ammonium ion, a non-ionic diblock polymer, a non-ionic triblock polymer, and a saccharide - based polymer.

8. A process for the production of an organofunctional silica with a mesocellular foam structure with framework silicon centers and an anhydrous formula $(SiO_2)_{1-x}(LSiO_{1.5})_x$, wherein L represents one or more organo groups linked to the framework silicon centers through a carbon - silicon bond and x is a fraction of the framework silicon centers that are organofunctional, comprising the steps of combining a basic aqueous solution of silicate anions with a solution containing a surfactant, an emulsifying agent, and at least one hydrolyzable organosilane reagent in an acidified non-aqueous polar solvent, wherein a dielectric constant of the non-aqueous solvent is greater than about 70 at 25°C, to obtain a reaction mixture as an emulsion with a pH between 1 to 10, allowing the reaction mixture to age at temperature between 0° and 150°C effective to produce an organofunctional mesocellular silica foam composition intercalated by the surfactant, and removing the surfactant from the intercalated product by solvent extraction.

9. The process of Claim 8 wherein the hydrolyzable organosilane reagent used to produce the organofunctional mesocellular foam silica composition has the formula $LSiY_3$ where L is the organofunctional group and Y is a hydrolyzable moiety selected from the group consisting of halide and alkoxide.

10. The process of Claim 8 wherein the organofunctional group of the organofunctional mesocellular silica foam composition contains one or more heteroatoms selected from the group consisting of oxygen, nitrogen, sulfur, phosphorus, boron, and a halogen, and combinations thereof.

11. The process of Claim 8 wherein the anhydrous formula $(SiO_2)_{1-x}(LSiO_{1.5})_x$ for the organofunctional mesocellular silica foam composition has a value of x = 0.01 to 0.30, corresponding to the fraction of the framework silicon centers linked through carbon - silicon coavalent bonds to one or more organo groups.

12. The process of Claim 8 wherein the solvent used to extract the intercalated surfactant is an alcohol which can optionally contain a protonic acid.

13. The process of Claim 8 wherein the surfactant is selected from the group consisting of a non-ionic diblock polymer, a non-ionic triblock polymer, and a saccharide-based polymer.

14. The process of Claim 8 wherein the emulsifying agent is 1,3,5-trimethylbenzene.

15. The process of Claim 8 wherein the emulsifying agent is selected from the group consisting of mono- and poly-alkylated benzenes and alcohols with 8 or more carbon atoms.

16. The process of Claim 8 wherein the non-aqueous polar solvent is formamide, which can optionally contain an acid.

17. A process for the production of a mesostructured organofunctional silica-alumina composition with framework silicon centers with an anhydrous formula $(SiO_2)_{1-x}(LSiO_{1.5})_x(Al_2O_3)_y$, wherein L represents one or more organo groups linked to the framework silicon centers through a carbon-silicon bond, x is the fraction of framework silicon centers that are organofunctional, and y is number of AlO_4 and AlO_6 units that are linked to framework SiO_4 and $LSiO_3$ units, comprising the steps of combining a basic aqueous solution of silicate and aluminate ions, hydroxide ions as a base, zeolite-directing counter cations, and at least one hydrolyzable organosilane reagent, aging the solution at or above ambient temperature for a period effective to produce protozeolitic aluminosilicate clusters in solution, reducing the pH of the mixture to a value of 10 or below through the incorporation of an acid, adding a surfactant to form a reaction mixture, aging the reaction mixture at a pH between about 1.0 and about 10 at a temperature between 0° and 150°C at a surfactant to silicon ratio effective to produce a mesostructured organofunctional silica - alumina composition intercalated by the surfactant and removing the surfactant from the intercalated product by solvent extraction.

18. The process of Claim 17 wherein the hydrolyzable organosilane reagent used to produce the mesostructured organo silica - alumina composition has the formula $LSiY_3$, wherein L is the organofunctional group and Y is a hydrolyzable moiety selected from the group consisting of halide and alkoxide.

19. The process of Claim 17 wherein the mesostructured organofunctional silica - alumina composition has the anhydrous empirical formula $(SiO_2)_{1-x}(LSiO_{1.5})_x(Al_2O_3)_y$, where L is one or more organofunctional group linked to the framework silicon centers through a carbon - silicon covalent bond, x = 0.01 to 0.65 and y = 0.005 to 0.50.

20. The process of Claim 17 wherein the organofunctional group L of the mesostructured organofunctional silica - alumina composition contains one or more heteroatoms selected from the group consisting of oxygen, nitrogen, sulfur, phosphorus, boron, and a halogen, and combinations thereof.

21. The process of Claim 17 wherein the framework structure of the mesostructured organofunctional silica - alumina composition is hexagonal or wormhole.

22. The process of Claim 17 wherein the solvent used to extract the intercalated surfactant is an alcohol which optionally contains a protonic acid.

23. The process of Claim 17 wherein the surfactant used to produce the mesostructured organofunctional silica - alumina composition is selected from the group consisting of an alkyl amine, a cationic quaternary ammonium ion, a non-ionic diblock polymer, a non-ionic triblock polymer, and a saccharide - based polymer.

24. A process for producing an organofunctional mesocellular silica - alumina foam composition with framework silicon centers with an anhydrous empirical formula $(SiO_2)_{1-x}(LSiO_{1.5})_x(Al_2O_3)_y$, wherein L represents one or more organofunctional groups linked to the framework silicon centers through a carbon - silicon covalent bond and wherein x = 0.01 to 0.30, and y = 0.005 to 0.05, comprising the steps of forming a basic aluminosilicate solution from silicate anions, aluminate anions, and a zeolite - directing counter-cation in the minimum amount of water, aging the solution at a temperature effective to form protozeolitic nanoclusters in the solution, adding an organosilane reagent as a source of $LSiO_3$ units, aging the solution further to incorporate the $LSiO_3$ units into the protozeolitic nanoclusters, combining the resulting solution with an emulsion containing a surfactant, an emulsifying agent, and sulfuric acid to form a reaction mixture, lowering the pH of the reaction mixture to a value between about 1.0 and about 5.5, aging the reaction at a temperature between 0° to 150°C for a period of time effective to form a mesocellular foam structure intercalated by the surfactant and emulsifying agent, and removing he surfactant and emulsifying agent by solvent extraction.

25. The process of Claim 24 wherein the organofunctional group L of the mesocellular silica - alumina foam composition contains one or more heteroatoms selected from the group consisting of oxygen, nitrogen, sulfur, phosphorus, boron, and a halogen and combinations thereof.

26. The process of Claim 24 wherein the surfactant is a non-ionic ethylene oxide - propylene oxide triblock surfactant of the type PEO-PPO-PEO.

27. The process of Claim 24 wherein the surfactant is the triblock surfactant PLURONIC 123.

28. The process of Claim 24 wherein the zeolite - directing counter cation used to form the protozeolitic aluminosilicate nanoclusters is selected from the group consisting of alkali metal ions and quaternary ammonium ions.

29. The process of Claim 24 wherein the zeolite-directing counter cation used to form the protozeolitic aluminosilicate nanoclusters is sodium.

30. The process of Claim 24 wherein the organosilane for use as a precursor to the $LSiO_3$ framework units has the formula $LSiY_3$, wherein Y is a hydrolyzable moiety selected from the group consisting of a halide and alkoxide moiety and L is the organofunctional group bonded to silicon through a carbon silicon bond.

31. The process of Claim 24 wherein the emulsifying agent is selected from the group comprising trialkylated benzenes and alkanes and alkyl alcohols containing eight or more carbon atoms.

32. The process of Claim 24 wherein 1,3,5-trimethylbenzene is the emulsifying agent.

33. An organofunctional silica composition with a mesocellular foam framework structure and an anhydrous formula $(SiO_2)_{1-x}(LSiO_{1.5})_x$, wherein L represents one or more organo groups linked to framework silicon centers through a carbon - silicon bond and wherein x = 0.01 to 0.30 is a fraction of framework silicon centers that are organofunctional.

34. A mesostructured organofunctional silica-alumina composition with framework silicon centers with an anhydrous formula $(SiO_2)_{1-x}(LSiO_{1.5})_x(Al_2O_3)_y$, wherein L represents one or more organo groups linked to the framework silicon centers through a carbon - silicon bond, x = 0.01 to 0.65 is the fraction of the framework silicon centers that are organofunctional, and y = 0.005 to 0.50 is number of AlO_4 and AlO_6 units that are linked to framework SiO_4 and $LSiO_3$ units and wherein the framework structure is hexagonal or wormhole.

35. An organofunctional mesocellular silica - alumina foam composition with framework silicon centers with an anhydrous empirical formula $(SiO_2)_{1-x}(LSiO_{1.5})_x(Al_2O_3)_y$, wherein L represents one or more organofunctional groups linked to the framework silicon centers through a carbon - silicon covalent bond and wherein x = 0.01 to 0.30, and y = 0.005 to 0.05.

36. The composition of any one of Claims 33, 34 or 35 wherein the organo group L is comprised of carbon and hydrogen only.

37. The compositions of any one of Claims 33, 34 or 35 wherein the organo group L is comprised of carbon, hydrogen and one or more heteroatoms selected from the group consisting of boron, nitrogen, phosphorus, oxygen, sulfur, and halogen and combinations thereof.